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Junior high industrial arts safety test

Gordon Edward Johnson
Iowa State College

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JUNIOR HIGH INDUSTRIAL ARTS SAFETY TEST

by

Gordon Edward Johnson

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
MASTER OF SCIENCE

Major Subject: Industrial Education

Signatures have been redacted for privacy

Iowa State College

1957

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INTRODUCTION

The field of personal safety has grown in importance within the last few years. Each year many people are killed or injured in accidents which might have been prevented. In the United States during 1955 accidents were responsible for 93,000 deaths and 9,350,000 injuries.¹ We find people are rapidly becoming aware of the problem of accidents. School Review stated that "The accident toll has reached such appalling numbers as to constitute a serious threat to our national well being."² The federal and state governmental agencies as well as private organizations are working toward improved personal safety.

Attempts have been made to decrease the number of accidents through safety education and safety engineering. Many guards, safety switches, and other safety devices have been designed to provide increased safety for the worker. Schools are establishing driver education classes, and are placing more emphasis upon the teaching of safety as part of regular classes. Elementary schools are introducing safety as part of their regular class instruction. Henry Armsby in a report of a sub-committee of the Presidents Conference on Occupation-

¹National Safety Council. Accident facts. 425 North Michigan Ave., Chicago 11, Illinois. 1956. p. 3.

²H. A. Anderson. Education for safety. School Review 57: 331-33. 1949. p. 331

al Safety states: "Any understanding of accident prevention in industry must be built upon a strong foundation of general safety knowledge gained to a considerable extent through impressions made in the elementary schools."¹

Industrial arts instructors find themselves in an excellent position to teach safety as part of the regular industrial arts class. It is stated that: "Habits formed by students during this period will be present as he moves into industry."² Many methods have been used in the teaching of safety in industrial arts classes. Some instructors use films, filmstrips, posters and other visual aids. Others prefer safety tests, safety check-out sheets, safety rules, and many other methods in the teaching of safety.

It is a difficult task to evaluate and select the best methods for the teaching of safety in the industrial arts classroom. The test constructed in this study has been designed to aid the junior high industrial arts instructor in the teaching of general safety factors in his industrial arts classes. It is designed to serve as a means of measuring the general safety information of students entering the industrial arts class. It may serve as a guide to the instructor in selecting important safety factors which should be taught in the

¹Henry J. Armsby. Occupational safety and the schools. School Life 37, no. 1: 10, 15. October 1954. p. 10.

²Ibid., p. 15.

industrial arts classroom. By testing students when they enter class and again when they complete the course, the instructor can check the effectiveness of his method of teaching general safety concepts in the industrial arts classroom.

REVIEW OF LITERATURE

Very little material was found dealing directly with safety tests for junior high industrial arts. Several studies were reviewed dealing with the number and nature of accidents occurring in the industrial arts shop. Substantial material was found dealing with safety, safety education, test construction, and other material related to this study.

Stone¹ made a study of accidents occurring in 153 Industrial Arts Shops in Iowa. He found that wood shops were responsible for more than 28 per cent of the reported accidents. In Stone's study the auto mechanics shop had the highest accident rate with an average of 7.33 accidents per shop. Stone found that hand tools were involved in 51 per cent of the accidents and power tools in 21½ per cent. The chisel was involved in more than half of the accidents due to hand tools. The hand saw was next, resulting in 8 per cent of the accidents. The circular saw and the metal lathe were each responsible for about 15 per cent of the accidents involving the use of power tools.

In a study² of accidents and safety education in the

¹Ray B. Stone. Accidents and their causes in selected industrial arts shops of Iowa. Unpublished M. S. Thesis. Ames, Iowa, Iowa State College Library. 1953.

²Wayne M. Judy. Accidents and safety education in the industrial arts shops of Iowa. Unpublished M. S. Thesis. Ames, Iowa, Iowa State College Library. 1932.

Industrial Arts Shops of Iowa, Judy reported carelessness was responsible for about 45 per cent of the accidents. Disobedience of rules accounted for about 13 per cent and hasty work for another 9 per cent.

Stack¹ stated "Every accident has a cause. There is no such thing as an accident without a cause They do not happen by chance." With increased interest in the prevention of accidents, several attempts have been made to improve shop safety instruction.

Kranzusch² developed an instructional test in shop safety. He compiled a list of situations involving factors of safe and dangerous practices typical to the industrial arts shop. He used only those items which could be illustrated with the equipment available in the Industrial Arts Shop at Iowa State College. In his study he developed an instructional test composed of 35 illustrations depicting safe and dangerous situations in the industrial arts shop. Marcus E. Erickson³ developed a multiple choice test over various shop

¹Herbert J. Stack, Charles C. Hawkins, and Walter A. Cutter. Careers in safety. New York, Funk and Wagnalls Co. 1945.

²Ray F. Kranszuch. The development of an instructional test in shop safety. Unpublished M. S. Thesis. Ames, Iowa, Iowa State College Library. 1941.

³Marcus E. Erickson. Examinations in school-shop safety. Industrial Arts and Vocational Education 44, no. 4: 134-6. April 1955.

tools and areas of shop work. Many of the questions involved the use of power tools. It would be a suitable test for some areas of high school industrial arts. Its use for junior high would be limited.

Educators are recognizing the fact that safety education is more effectively taught as a part of the regular existing classes. Many feel that the school is the best agency for teaching safety. Jelinek¹ believes it should be taught as a part of the regular work, and it should be taught for life, not just for the duration of the industrial arts course. Henry E. Armsby² reported:

. . . . The American School System is the best organized agency to reach effectively the largest percentage of the population and that the schools have a dual responsibility in Safety Education. First, they must provide and maintain a safe environment as a basis for accident-free operation and as an example of safe working conditions. Second, they have a responsibility for safety instruction, preferably developed as an integral part of many subjects rather than as a distinct and separate subject within itself.

Thorndike and Hagen³ report that either the empirical or the rational method may be used when determining the evidence of validity of a test. In the rational method, the content

¹Robert E. Jelinek. Teach safety for life. Safety Education 33, no. 2: 3-5. October 1953.

²Armsby, op. cit., p. 10.

³Robert L. Thorndike and Elizabeth Hagen. Measurement and evaluation in psychology and education. New York, John Wiley and Sons. 1955. pp. 108-23.

of the test should reflect the content of the course or subject area being tested. This involved examining the content of the test or test plan. This may be done by ones own judgement, or by the pooled judgement of a group of people experienced in the area over which the test is testing. The empirical type of validity may be determined by comparing the test statistically with other valid criterion. The rational method was used in the construction of the general safety test in this study.

Additional sources of information used in the construction of the test for this study were films, filmstrips, safety posters and safety instruction books. The film Industrial Arts: A Safe Shop¹ was viewed to obtain safety factors for this study. It showed various safety factors which should be taught in the industrial arts shop.

¹O. A. Hankammer, advisor. Industrial arts: a safe shop. New York 17, New York, Young America Films, Inc., ca. 1952. (Motion picture film)

THE INVESTIGATION

Construction of the Test

The first step in the construction of this test involved gathering a list of safety factors which should be taught in the industrial arts classroom. Several sources of information were used in compiling this list. The film¹ Industrial Arts: A Safe Shop was viewed and used as a valuable source of information in selecting these safety factors. Additional information was secured from safety posters, instruction sheets, and from careful observation of safety factors in the industrial arts shop.

The list of items were then checked to see if they involved factors present in the junior high industrial arts shop. Only those items which seemed to be important at the junior high level were left for further consideration. The items were selected to reflect the various areas being taught at the junior high level. Questions were then written about each item. The questions were in the form of a statement concerning some things a student might do in an industrial arts shop. If the student thought the act was safe, he was to mark S, if unsafe, U.

The items were written so they could easily be understood

¹Hankammer, op. cit.

by junior high students. It was felt that reading ability might be a factor in determining the test score if the items were difficult to read and understand. The first draft of the test contained 75 items. It was given to several 8th grade students for the purpose of clarifying questions which students had difficulty in understanding. A list of the questions they asked were used to clarify several questions in the test.

It was felt that the pooled judgement of several instructors and educators in the field of industrial arts would be better than the opinion of one individual. For the purpose of this study, the following basic assumption has been made: That a selected panel of 15 experienced industrial arts instructors is sufficient to select valid items for a shop safety test. Thorndike and Hagen¹ listed rational evidence as one type of evidence used for determining the validity of a test. This was used in selecting valid items for this test. A list of safety items relating to the junior high industrial arts shop was compiled and questions over these items were constructed.

Letters were sent to 20 selected industrial arts instructors in Iowa. It was felt better judgement of the items would result if the instructors were selected from several

¹Thorndike and Hagen, op. cit., pp. 108-23.

teaching levels of industrial arts. Three college instructors, twelve junior high, and five high school instructors were written letters explaining the test and requesting that they check over the proposed items. Each instructor was asked to reply on an enclosed card if he could check over the test. The test was not included with the first letter. It was felt if the test were sent out without first contacting the instructors, many of the tests would not be returned and many of those returned would not receive proper attention.

Replies were received from 19 of the instructors indicating they would look over the test items. The test items¹ were sent to the instructors along with a sheet of instructions requesting that each instructor list the number of each item he felt should not be included in the test. The instructors were asked to score the items they thought safe S, and those they thought unsafe, U. Space was included for listing additional items not included in the test and for suggestions for the improvement of the test.

The last 14 items of the final draft of the test were constructed from suggestions received from the instructors. Many of these suggestions listed additional items for the test. Others concerned suggestions for the wording of test

¹A copy of the test items sent to the instructors, the letter asking for their participation, instructions for checking the test, and the final draft of the test are found in the appendix.

items. Of the 19 tests sent out, 15 were returned (one too late for use). The following are comments from instructors concerning various suggestions for the construction of this test:

"I would not include item 19 because I do not take off my watch and ring when working."

"Turn on machine for someone else--store wood under benches so wood sticks out--use safety goggles when drilling with drill press."

"You might say: You drill an anchor hole of proper size before starting a screw."

"Re-word #40 to 'return to proper place'."

"Horseplay is entirely out of place in the shop."

Several items were omitted in the final draft of the test. Items which three or more instructors thought should be left out were omitted. Items over which three or more instructors disagreed over the proper answer were omitted. This level for the omission of items was selected arbitrarily. The question was raised about items concerning safety to the tools. They were omitted as it was felt many of the students taking the test would think the items referred to personal safety. Others overlapping previous items were also omitted.

A chart was constructed to record the remarks made by the instructors about each test item. Question number 1, representative of the questions, was scored as follows:

Table 1. Scoring of question number 1 by the shop instructors

	Instructor														
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Safe					X				X	X	X	X			
Unsafe			X			X	X	X					X		X
Left out	X			X											
Improved															

Administration of the Test

The completed form of this test was given to 173 junior high students attending seven different schools in Central Iowa. The schools selected did not offer industrial arts to junior high students. The schools ranged in size from almost 150 total enrollment to that of approximately 1100 students. The principal or the superintendent of each school participating was contacted for the purpose of obtaining permission to give the tests to his junior high students. This was done by going to each school and talking directly with the administrators. The purpose of the test was explained to them along with the instructions for the administration of the test. The administration of the test was left to the superintendent or principal of the school used, as it was difficult to arrange a suitable schedule for administration of the

tests. The tests were given to the students about one week before the end of the school year.

Results of the Study

Several methods were used in the treatment of the statistical data received from the administration of this test. The coefficient of reliability was found for the whole test, the first 60 items and the last 14 items. The standard error of the test was computed along with the mean scores for various parts of the test. In addition, the data received other statistical treatment.

The coefficient of reliability of this test was computed by finding the coefficient of correlation between the scores on the odd and the even items. This was computed by formulas listed by Wert et al.¹

The coefficient of correlation between the odd and even items is found by the formula

$$r_{oe} = \frac{\sum OE - \frac{(\sum O)(\sum E)}{N}}{\sqrt{\left[\sum O^2 - \frac{(\sum O)^2}{N}\right]\left[\sum E^2 - \frac{(\sum E)^2}{N}\right]}}$$

where

r_{oe} = coefficient of correlation

¹James E. Wert, Charles O. Neidt, and J. Stanley Ahmann. Statistical methods in educational and psychological research. New York, Appleton-Century-Crofts, Inc. 1954.

Table 2. Sums, sums of squares, and cross-products of data for the safety test given to junior high students

	74 items	60 items	14 items
ΣO	5557	4643	914
ΣE	5593	4641	952
ΣO^2	181837	126971	5004
ΣE^2	184345	126803	5528
ΣOE	182672	126585	5127

ΣO = sum of scores of odd items

ΣE = sum of scores of even items

ΣOE = sum of cross products

ΣE^2 = sum of squares of even items

ΣO^2 = sum of squares of odd items

An estimate was made of the expected coefficient of reliability of the test. For a test twice as long as either half of the test, the estimated coefficient of reliability may be found by the formula

$$r_{xx} = \frac{2r_{oe}}{1 + r_{oe}}$$

where

r_{xx} = the coefficient of reliability of the test

r_{oe} = the coefficient of correlation between the odd and even items

In order to estimate the coefficient of reliability of

a test any number of times as long as the test forms used in the original computation of the coefficient of correlation, one may use the Spearman-Brown formula

$$r_{N_{xx}} = \frac{N r_{xx}}{1 + (N-1) r_{xx}}$$

where

$r_{N_{xx}}$ = the reliability coefficient of a test
after lengthening

N = the number of times the test is to be
lengthened

r_{xx} = the coefficient of correlation between
forms prior to lengthening

The coefficient of reliability was found for the whole test, for the first 60 items, and the last 14 items. This was done because the test was constructed in two sections. The first section contained items selected by industrial arts instructors and the last 14 items were constructed from suggestions for additional items received from these instructors. The coefficient of correlation was computed for the whole test and each section of the test. The coefficient of reliability was then found by using the coefficient of correlation. An estimate of the coefficient of reliability was made for each test section had it contained 74 items.

A slightly higher estimated coefficient of reliability was found for the first 60 items than that found for the last

Table 3. Coefficient of correlation between the scores of the odd and even items

74 items	First 60 items	Last 14 items
.689	.655	.234

Table 4. Estimated coefficient of reliability for a test of 74 items

74 items	First 60 items	Last 14 items
.816	.824	.763

14 items. An estimated coefficient of reliability of .824 and .763 was found when each was expanded to 74 items.

The question often arises concerning the importance of the coefficient of reliability for such a test. A coefficient of reliability of .816 was found for the whole test constructed in this study. One way to describe the meaning of the coefficient is in terms of the standard error of the test. A standard error will indicate the variation in the test score you might expect if you were to give the test to a group of people. In a large number of subjects you would expect 68 out of 100 subjects taking the test again to make scores within the previously obtained score plus or minus the standard error of the test. The standard error of a test score may be found from the formula

$$\sigma_{\text{score}} = \sigma_T \sqrt{1 - r_{xx}}$$

where

σ_{score} = standard error of measurement of a test

σ_T = standard deviation of test scores in the group in which the coefficient of reliability has been computed

r_{xx} = the coefficient of reliability of the test

$$\begin{aligned}\sigma_{\text{score}} &= 4.05 \sqrt{1 - .816} \\ &= 1.737\end{aligned}$$

The standard error of the whole test was found to be 1.737. This means that in a large number of subjects, the true score of 68 out of every 100 subjects should be within their obtained score plus or minus 1.737. 95 out of 100 subjects should be within their obtained score plus or minus 3.40.

A level of difficulty score was obtained for each test section. This was computed by finding the percentage of the items answered correctly by all the students taking the test. 68.1 per cent of all the items were answered correctly. The first 60 items were slightly easier being answered correctly by 90.5 per cent of the students. A score of 77.9 per cent for the last 14 items would indicate those items were more difficult.

Table 5. Level of difficulty

	74 items	60 items	14 items
Percentage of all questions answered correctly	88.1	90.5	77.9

A check was made of the mean scores over the various sections of the test. A difference of .20 was found between the mean scores of the odd and even items for the whole test. A difference of .01 was found between the mean score on the first 60 items, and a difference of .23 for the last 14 items. This indicates little difference between the mean scores of the odd and even items.

Table 6. Mean scores made by students over various sections of the test

	74 items	60 items	14 items
Odd items	32.50	27.15	5.34
Even items	32.70	27.14	5.57
All items	65.20	54.29	10.91

An attempt was made to show that there was no significant difference between the scores made by the 7th and the scores made by the 8th and 9th grade students taking this test. A test was made of the null hypothesis that: There is no dif-

ference between the scores made by the 7th grade male students and the scores made by the 8th and 9th grade male students taking the general safety test constructed in this study. The 8th and 9th grade scores were combined for the test as only five 9th grade scores were used in this study. Analysis of variance was used to obtain a t value of .730. With a t value of .730 we cannot reject the null hypothesis. Available evidence fails to provide proof that there is any difference in the scores made by the 7th, 8th and 9th grades.

Table 7. Analysis of variance of scores made by 7th grade male students and scores made by 8th and 9th grade male students

Source of variation	Degrees of freedom	Sum of squares	Mean square
Groups	1	14.09	14.09
Within groups	169	4477.75	26.49
Total	170	4491.84	

The sum of squares for the group is found by the expression

$$\begin{aligned}
 SS_g &= \frac{(\sum X_1)^2}{K_1} + \frac{(\sum X_2)^2}{K_2} + \frac{(\sum X_T)^2}{N} \\
 &= 14.09
 \end{aligned}$$

where

K_1 = number of students in the 7th grade

K_2 = number of students in the 8th and 9th grades

ΣX_1 = sum of scores for 7th grade students

ΣX_2 = sum of scores for 8th and 9th grade students

$\Sigma X_1 + \Sigma X_2$ = sum of scores made by all students

The sum of squares for the total is found by the expression

$$\Sigma X_T^2 = \frac{(\Sigma X_T)^2}{N}$$

$$SS_T = 4477.75$$

Table 8. Sums of squares for 7th grade, and 8th and 9th grades

ΣX_1	7th grade	8th and 9th grade	
	ΣX_1^2	ΣX_2	ΣX_2^2
4866	317506	6284	414018

The item analysis of the test questions lists the percentage of students missing each item. The percentage ranges from 88.89 for question number 64 to .58 for question number 52. This indicates several items are too easy and should not be included in the test. In using this test, a person could omit all the questions missed by less than 10 per cent (or

any other arbitrary value) of the students and include questions over other areas of safety. It also indicates areas in which students should have more instruction.

Most students seemed to think it safe to wear gloves in most shop situations. Most of the students answered questions correctly concerning wearing gloves when handling hot metal (94.15%), acid (95.91%), rough lumber (97.66%), and scraps of metal (94.15%). They also seemed to think that gloves should be used when working on the lathe (missed by 88.89%). Other items dealing with inflammable material was answered correctly by most of them. As might be expected, questions dealing with power tools were missed by a large number of students. The four questions answered incorrectly most often by the students involved the use of power tools.

This item analysis will indicate to the instructor several areas of safety with which junior high students are generally familiar. It will also point out areas where additional instruction would be needed. This test could be given to a group of students entering an industrial arts class which would help the instructor select areas of shop safety needing more emphasis.

Table 9. Percentage of students missing each item

Percentage	Item no.	Item
88.89	63.	You wear gloves when turning wood on the lathe.
46.20	41.	You give the jig saw a few turns by hand to check its adjustment.
44.44	26.	You help another student turn a piece of wood on the lathe.
41.52	40.	You slow down the lathe to brush off the dust.
39.18	62.	The chisel you are using is very sharp.
35.67	67.	You blow sawdust from a board you are sawing.
35.67	19.	You experiment to find the proper way to use a new tool.
33.33	3.	When sharpening a chisel, you find the guard has been removed, so you stand to one side and sharpen your chisel.
30.99	73.	When using a band saw you raise the guard several inches above your work.
30.41	18.	You clinch the end of a nail that goes through a board.
25.73	38.	You stand behind the lathe to watch another student work.
23.98	66.	You place oily rags in a wooden box.
23.39	72.	You turn on the drill press for another student.
22.22	16.	To force the claws of a hammer under a nail, you pound one hammer with another hammer.
20.47	35.	You place scrap boards on the floor beside your bench.

Table 9. Continued

Percentage	Item no.	Item
20.47	74.	You stand to one side of the blade when using a circular saw.
18.13	70.	You hold your work by hand when drilling with the drill press.
15.20	53.	You place tools near the edge of your desk until the end of the period.
13.45	54.	When painting, you allow plenty of fresh air to enter the room.
13.45	13.	You use a screwdriver that fits loosely in the screw.
12.28	33.	You lift with your back when moving a heavy object.
10.53	27.	You oil the lathe when it is running.
9.94	20.	You roll your loose shirt sleeves before starting work in the shop.
9.94	8.	When using a chisel, you hold the piece of wood in a wood-vise.
9.37	1.	In shop class, you learn how to use the fire extinguisher.
8.19	46.	The head of the cold chisel you are using has been flattened out of shape.
7.60	9.	The chisel you are using is dull.
7.60	21.	You use a chisel with a chipped blade.
7.02	23.	The piece of wood you turn on the lathe has small cracks.
7.02	48.	You use an extension cord with a loose plug on one end.

Table 9. Continued

Percentage	Item no.	Item
6.43	2.	You wear goggles or a face shield when using the lathe.
6.43	10.	You slide your finger across the bottom of a plane to see how deep it is set.
6.43	69.	You wear goggles when drilling holes with the drill press.
6.43	45.	You wiped up some grease you spilled on the floor.
5.85	4.	When working, you make sure the floor around your bench is clean.
5.85	55.	You rush to the tool cabinet so you may get the tools for your work.
5.85	56.	You don't talk to students while they are using power tools.
5.85	68.	You wear gloves when picking up scraps of metal.
5.85	64.	You wear gloves when handling hot metal.
5.26	34.	You carry a screwdriver in your pocket.
5.26	25.	You heat a soldering iron and carry it across the room to your bench.
5.26	17.	You drill a small anchor hole before starting a screw.
5.26	39.	You visit with another student while he is working on the lathe.
4.68	22.	A student is using a file which has no handle.
4.68	42.	You stop the lathe to check the measurements of the piece you are turning.

Table 9. Continued

Percentage	Item no.	Item
4.68	37.	You close your wood-vise at the end of the period.
4.09	6.	You are working with your shop apron strings untied.
4.09	14.	You use a knife blade to pull tacks.
4.09	15.	When you cut your hand, you apply first aid.
4.09	49.	You open several windows in order to cool off quickly after becoming warm.
4.09	31.	You throw scrap lumber across the room to the trash box.
4.09	71.	Some of the pieces of lumber stored under your bench stick out from under it.
4.09	61.	You spilled acid cleaning solution on your foot, but as it does not burn or feel uncomfortable, you continue working.
4.09	58.	You wear rubber gloves when handling acid cleaning solution.
3.51	47.	You wear goggles when chipping metal with a chisel.
2.92	43.	You use a ladder with a cracked step to reach a high step.
2.92	28.	Your neighbor visits with you while he is chiseling a groove in a board.
2.92	29.	To have nails handy when putting your project together, you hold them in your mouth.
2.92	36.	You continue working until the end of the period with a splinter in your finger.
2.92	59.	You carry an open knife in your pocket.

Table 9. Continued

Percentage	Item no.	Item
2.34	57.	You learn to apply first aid and to treat minor shop injuries.
2.34	30.	You wear gloves when carrying rough lumber.
2.34	24.	You pretend to throw a piece of wood at another student.
2.34	44.	You are soldering next to a person who is removing grease with gasoline.
2.34	11.	You see that no piece of wood containing nails is left on the floor.
2.34	7.	You are painting near a student who is using a blowtorch.
2.34	51.	You toss pliers to a student across the room who needs them for a job.
1.75	32.	You check the handles of your tools to see that they are tight.
1.75	60.	When using any liquid which will burn, you make sure no sparks or fire are near.
1.75	65.	When in a hurry, you run to get the tools you need.
1.17	50.	You report damaged tools to your instructor.
1.17	12.	You keep the lumber for your project stacked in an orderly pile.
1.17	5.	After wiping up paint, you place the oily rags in your desk drawer.
.58	52.	You tell your teacher about a tool which has a broken guard.

SUMMARY

As our society increases in size and complexity, increased emphasis is being placed upon the importance of safety. With an increase in the mechanization of industry and the home, there is a greater need for personal safety. Experimentation has increased the safety of the equipment with which we work. Work is being done to develop safe acting and safe thinking individuals. Safety campaigns, films, posters, and instruction are a few of the methods being used to instill safety consciousness in the American People.

A safety test was constructed in this study. It was not designed to cover all areas of safety. Its main purpose is to serve as an aid to the junior high industrial arts instructor in the teaching of general safety concepts.

This test was constructed with the help of selected industrial arts instructors. They selected items, from a list of questions, which were used in the construction of this general safety test for junior high industrial arts. In addition they furnished suggestions for improving existing items and suggestions for additional items. Items which three or more instructors indicated they thought should be omitted were left out. The instructors indicated whether they thought the items safe or unsafe. Items over which three or more instructors disagreed over the correct answer

were omitted. The final draft of the test consisted of 74 items.

The test was given to 173 junior high male students attending seven different schools in Central Iowa. The students whose scores were used in the statistical treatment of the test had never taken an industrial arts or shop course before. They were thus selected because the test is designed to measure the safety information of students entering an industrial arts class.

The coefficient of correlation between the odd and even items was computed and found to be .689. The Spearman-Brown formula was used in computing the coefficient of reliability. It was found to be .816 for the whole test.

The standard error of the test was computed and found to be 1.731. If the test were given to a large group of people, you could expect their true score to be within their obtained score plus or minus 3.40 in 95 out of 100 cases.

Available evidence failed to prove that there is any difference in the scores made by the 7th grade, and the scores made by the 8th and 9th grade. An analysis of variance test resulted in a t value of .730. The null hypothesis that: There is no difference between the scores made by the 7th grade male students and the scores made by the 8th and 9th grade male students taking the general safety test constructed in this study could not be rejected. The 8th and 9th grade

scores were combined for the test as only five 9th grade scores were used in this study.

An item analysis was developed over the test items. The percentage of students missing each item was computed. It indicated several areas of safety that would need little emphasis in junior high industrial arts. Other areas were indicated that the students should have more instruction.

The main objective of this study was to develop an instrument which would aid the industrial arts instructor in teaching safety. The test points to areas where increased emphasis will be needed when teaching safety. Other areas are indicated that will need little emphasis. A shop instructor using this test could modify the items to suit his classroom situation in teaching general safety principles in junior high industrial arts.

DISCUSSION

Many industrial arts instructors are trying to teach safety as a part of the regular instruction in their classrooms. Up to the present time very little has been done to indicate which method, or methods of teaching safety are most effective. Many times an industrial arts instructor may wish to try various methods of teaching safety in the shop. It is a difficult task to evaluate such teaching in view of the few existing tests over general safety.

Some attempts have been made to develop tests to measure safe attitudes. This has been difficult due to the limited information about the nature of attitudes, the changing of attitudes, and the stability of attitudes. The past decade has brought about an increase in the study of safety and safe attitudes. Psychologists and safety educators are attempting to solve questions as: "Are some people accident prone?" "Do attitudes toward safety change from time to time?" "If so, does this change take place over a period of years, weeks, or just a few minutes?"

When we are able to answer these and other questions concerning safety, we may be able to give each student a test and predict how safe he will be in school and how safe a worker he will be in industry. Until we have such a means of measuring and teaching safety, we must continue to teach safety by our

present methods.

The test constructed in this study may be used as an aid to the industrial arts instructor. It may be used to point out areas in which the students need additional information. It will allow the instructor to place more emphasis upon some areas of safety, and less on others. This does not imply that because most students answer an item correctly that we do not need to cover that area. Each area should receive emphasis and the student should be instructed in proper and safe working habits in the industrial arts classroom. These habits formed in the classroom should be of such a nature that they will be applied in all activities. They should be carried into industry and every day life.

Very little research has been done dealing with the teaching of safety to students. It is hoped that in the coming years more research will be done in this area. A test such as developed in this study could be used to enable investigators to study the effectiveness of various methods of teaching safety.

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APPENDIX

Boxholm, Iowa
April 1, 1957

Dear Mr.

As part of my graduate work in Industrial Education at Iowa State College, I am working on the development of a general safety test for junior high industrial arts.

I am asking several industrial arts instructors and educators to look over the proposed items for this test and to check the items that they think are suitable for a general safety test in junior high industrial arts. The final test will be composed of these selected items.

Would you look over the proposed items for this test and check those that you think are suitable for such a test? If so, these items will be sent at a later date. Please reply by April 6, 1957 on the enclosed card.

Sincerely yours,

Gordon E. Johnson
Boxholm, Iowa

GEJ/gj
Enclosure 1

Dear Shop Instructor:

Enclosed is a list of the proposed items for a general safety test in junior high industrial arts. This test is designed to measure the general safety information of students entering or completing an industrial arts course. When completed, I intend to give this test to a number of junior high students. I will then run an item analysis of the test and check the reliability.

PLEASE TRY TO RETURN THIS SHEET AND THE TEST AS SOON AS POSSIBLE, AS I MUST GIVE THE TEST TO A GROUP OF STUDENTS BEFORE THE END OF THIS SCHOOL YEAR.

If you think the test items are safe, circle S; if unsafe, circle U.

List the number of the test items you think should not be included in this test.

Example 1, 19, 37.

List additional items not included in this test which you think should be included.

List further suggestions for the improvement of this test.

☐ Check if you would like a copy of the completed test.

Boxholm, Iowa
May 9, 1957

Dear Mr.

This test is to be given to the 7th, 8th and 9th grade students (boys) who haven't taken an industrial arts or shop course before. It is designed to measure the general safety information of students in these grades. It should take from 20-30 minutes to answer the questions.

The student is to darken the answer he thinks is correct. If he thinks the statement is safe, he is to darken S; if unsafe, he is to darken U. Please have the students fill in the name, age, school and grade.

Enclosed is a label to paste on this envelope to return the tests. Please return them as soon as possible. If you would like a copy of the results, send a note along with the tests.

Sincerely yours,

Gordon E. Johnson
Boxholm, Iowa

INDUSTRIAL ARTS SAFETY TEST

Name _____

Grade _____

Below are some of the things that might be done in industrial arts class. If you think the things are safe, circle S, if unsafe, circle U.

- S U 1. You start to work as soon as you get to class.
- S U 2. In shop class you learn how to use the fire extinguisher.
- S U 3. You wear goggles or a face shield when using the lathe.
- S U 4. When sharpening a chisel you find the guard has been removed, so you stand to one side and sharpen your chisel.
- S U 5. When working you make sure the floor around your bench is clean.
- S U 6. After wiping up paint, you put the oily rag in your desk drawer.
- S U 7. You are working with your shop apron strings untied.
- S U 8. You are painting next to a student who is using a blow torch.
- S U 9. When using a chisel, you hold the piece of wood in a vise.
- S U 10. You carry a compass with the sharp end pointing ahead of you.
- S U 11. The chisel you are using is dull.
- S U 12. You slide your finger across the bottom of your plane to see how deep it is set.
- S U 13. You see that no piece of wood containing nails is left on the floor.
- S U 14. You keep the lumber for your project stacked in an orderly pile.

- S U 15. Your neighbor visits with you while he is chiseling a groove in a board.
- S U 16. To have nails handy, when putting your project together, you hold them in your mouth.
- S U 17. Another student is wearing gloves when handling rough lumber.
- S U 18. You throw a scrap piece of lumber across the room to the trash box.
- S U 19. You remove your watch and ring before starting to work.
- S U 20. You check the handles of your tools to see that they are tight.
- S U 21. A student is working in his school clothes.
- S U 22. You lift with your back when moving a heavy object.
- S U 23. You carry a screwdriver in your pocket.
- S U 24. When chiseling hard wood, you use a metal hammer to drive the chisel.
- S U 25. You place scrap boards beside your desk.
- S U 26. You continue working until the end of the period with a splinter in your finger.
- S U 27. The students the vises on their benches at the end of the period.
- S U 28. You use a screwdriver that fits loosely in the screw.
- S U 29. You pry boards apart with a screwdriver.
- S U 30. You use a knife blade to pull tacks.
- S U 31. When you scratch your hand, you apply first aid.
- S U 32. To force the claws of a hammer under a nail, you pound one hammer with another hammer.
- S U 33. You drill a small hole before starting a screw.
- S U 34. You clinch the end of a nail that goes through a board.

- S U 35. You experiment to find out the proper way to use a new tool.
- S U 36. You roll up your loose shirt sleeves before starting work in the shop.
- S U 37. You use a chisel with a chipped blade.
- S U 38. A student is using a file which has no handle.
- S U 39. The piece of wood you turn on the lathe has small cracks.
- S U 40. When you finish using a soldering iron, you place it in the tool rack.
- S U 41. You heat a soldering iron and carry it across the room to your bench.
- S U 42. You pretend to throw a piece of wood at another student.
- S U 43. You help another student turn a piece of wood on the lathe.
- S U 44. You oil the lathe when it is running.
- S U 45. You stand behind the lathe to watch another student work.
- S U 46. You visit with another student while he is working on the lathe.
- S U 47. You slow down the lathe to brush off the dust.
- S U 48. You give the jig saw a few turns by hand to check the adjustments.
- S U 49. You stop the lathe to check the measurements of the piece you are turning.
- S U 50. You use a wobbly ladder to reach a high shelf.
- S U 51. You are soldering next to a person who is removing grease with gasoline.
- S U 52. You wiped up some grease you spilled on the floor.
- S U 53. You pound small nails into a board with a plastic mallet.

- S U 54. The head of the chisel you are using has been flattened out of shape.
- S U 55. You wear goggles when chipping metal with a chisel.
- S U 56. You use an extension cord with loose insulation.
- S U 57. You open several windows in order to cool off quickly after becoming warm.
- S U 58. You report damaged tools to your instructor.
- S U 59. Before using your plane, you check to see if it is sharp.
- S U 60. You try to remove a bit of dirt from your eye by rubbing it with your finger.
- S U 61. You report to your instructor for first-aid when you burn your finger.
- S U 62. You toss pliers to a student across the room who needs them for a job.
- S U 63. You tell your instructor about a tool which has a broken guard.
- S U 64. You use pliers when tightening a screw on your plane.
- S U 65. You place tools near the edge of your desk until the end of the period.
- S U 66. You place your hand beside the saw blade to get it started cutting on the line.
- S U 67. When painting, you allow plenty of fresh air to enter the room.
- S U 68. You rush to the tool cabinet so you may get the proper tools for your work.
- S U 69. You don't talk to students while they are using power tools.
- S U 70. You learn how to apply first aid and to treat minor shop injuries.
- S U 71. You wear rubber gloves and apron when handling acids in class.

- S U 72. You carry an open knife in your pocket.
- S U 73. When using any liquid which will burn, you make sure no sparks or fire are near.
- S U 74. You use a wooden mallet to pound a few nails.
- S U 75. You spilled acid on your foot, but as it doesn't burn or feel uncomfortable, you continue working.

INDUSTRIAL ARTS SAFETY TEST

Below are some of the things you might do in industrial arts class. If you think the things are safe, darken S; if unsafe, darken U. Example number O is unsafe so U is darkened.

- S ● O. You use a hammer with a broken and splintered handle.
- S U 1. In shop class, you learn how to use the fire extinguisher.
- S U 2. You wear goggles or a face shield when using the lathe.
- S U 3. When sharpening a chisel, you find the guard has been removed, so you stand to one side and sharpen your chisel.
- S U 4. When working, you make sure the floor around your bench is clean.
- S U 5. After wiping up paint, you place the oily rags in your desk drawer.
- S U 6. You are working with your shop apron strings untied.
- S U 7. You are painting near a student who is using a blow torch.
- S U 8. When using a chisel, you hold the piece of wood in a wood-vise.
- S U 9. The chisel you are using is dull.
- S U 10. You slide your finger across the bottom of a plane to see how deep it is set.
- S U 11. You see that no piece of wood containing nails is left on the floor.
- S U 12. You keep the lumber for your project stacked in an orderly pile.
- S U 13. You use a screwdriver that fits loosely in the screw.
- S U 14. You use a knife blade to pull tacks.
- S U 15. When you cut your hand, you apply first aid.
- S U 16. To force the claws of a hammer under a nail, you pound one hammer with another hammer.
- S U 17. You drill a small anchor hole before starting a screw.
- S U 18. You clinch the end of a nail that goes through a board.
- S U 19. You experiment to find the proper way to use a new tool.
- S U 20. You roll your loose shirt sleeves before starting work in the shop.
- S U 21. You use a chisel with a chipped blade.
- S U 22. A student is using a file which has no handle.
- S U 23. The piece of wood you turn on the lathe has small cracks.
- S U 24. You pretend to throw a piece of wood at another student.
- S U 25. You heat a soldering iron and carry it across the room to your bench.
- S U 26. You help another student turn a piece of wood on the lathe.
- S U 27. You oil the lathe when it is running.
- S U 28. Your neighbor visits with you while he is chiseling a groove in a board.
- S U 29. To have nails handy when putting your project together, you hold them in your mouth.
- S U 30. You wear gloves when carrying rough lumber.
- S U 31. You throw scrap lumber across the room to the trash box.
- S U 32. You check the handles of your tools to see that they are tight.
- S U 33. You lift with your back when moving a heavy object.
- S U 34. You carry a screwdriver in your pocket.
- S U 35. You place scrap boards on the floor beside your bench.
- S U 36. You continue working until the end of the period with a splinter in your finger.
- S U 37. You close your wood-vise at the end of the period.

Name ----- Age -----

School ----- Grade -----

Have you taken an industrial arts or shop course before? Yes__ No__

- S U 38. You stand behind the lathe to watch another student work.
- S U 39. You visit with another student while he is working on the lathe.
- S U 40. You slow down the lathe to brush off the dust.
- S U 41. You give the jig saw a few turns by hand to check its adjustment.
- S U 42. You stop the lathe to check the measurements of the piece you are turning.
- S U 43. You use a ladder with a cracked step to reach a high shelf.
- S U 44. You are soldering next to a person who is removing grease with gasoline.
- S U 45. You wiped up some grease you spilled on the floor.
- S U 46. The head of the cold chisel you are using has been flattened out of shape.
- S U 47. You wear goggles when chipping metal with a chisel.
- S U 48. You use an extension cord with a loose plug on one end.
- S U 49. You open several windows in order to cool off quickly after becoming warm.
- S U 50. You report damaged tools to your instructor.
- S U 51. You toss pliers to a student across the room who needs them for a job.
- S U 52. You tell your teacher about a tool which has a broken guard.
- S U 53. You place tools near the edge of your desk until the end of the period.
- S U 54. When painting, you allow plenty of fresh air to enter the room.
- S U 55. You rush to the tool cabinet so you may get the tools for your work.
- S U 56. You don't talk to students while they are using power tools.
- S U 57. You learn to apply first aid and to treat minor shop injuries.
- S U 58. You wear rubber gloves and apron when handling acid cleaning solution.
- S U 59. You carry an open knife in your pocket.
- S U 60. When using any liquid which will burn, you make sure no sparks or fire are near.
- S U 61. You spilled acid cleaning solution on your foot, but as it does not burn or feel uncomfortable, you continue working.
- S U 62. The chisel you are using is very sharp.
- S U 63. You wear gloves when turning wood on the lathe.
- S U 64. You wear gloves when handling hot metal.
- S U 65. When in a hurry, you run to get the tools you need.
- S U 66. You place oily rags in a wooden box.
- S U 67. You blow sawdust from a board you are sawing.
- S U 68. You wear gloves when picking up scraps of metal.
- S U 69. You wear goggles when drilling holes with the drill press.
- S U 70. You hold your work by hand when drilling with the drill press.
- S U 71. Some of the pieces of lumber stored under your bench stick out from under it.
- S U 72. You turn on the drill press for another student.
- S U 73. When using a band saw you raise the guard several inches above your work.
- S U 74. You stand to one side of the blade when using a circular saw.

Test Key

1. S	21. U	41. S	61. U
2. S	22. U	42. S	62. S
3. U	23. U	43. U	63. U
4. S	24. U	44. U	64. S
5. U	25. U	45. S	65. U
6. U	26. U	46. U	66. U
7. U	27. U	47. S	67. U
8. S	28. U	48. U	68. S
9. U	29. U	49. U	69. S
10. U	30. S	50. S	70. U
11. S	31. U	51. U	71. U
12. S	32. S	52. S	72. U
13. U	33. U	53. U	73. U
14. U	34. U	54. S	74. S
15. S	35. U	55. U	
16. U	36. U	56. S	
17. S	37. S	57. S	
18. S	38. U	58. S	
19. U	39. U	59. U	
20. S	40. U	60. S	